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(54) Controlled atmosphere package for fruit and packaging method

(57) A method for packaging and a package of climacteric fruit (2) have been developed, wherein one or more unripe fruit (2) are sealed in a bag (3) of suitable material, having a preselected permeability to gas and aqueous vapour, and sealed hermetically; the bag (3) is filled with a modified atmosphere comprising oxygen in a quantity ranging from 2% to 20% by volume, carbon dioxide in a quantity ranging from 0% to 20% by volume, ethylene in a quantity ranging from 0% to 3% by volume, the remainder being nitrogen.

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Description

The present invention relates to a method for packaging climacteric fruit and a package obtained with said method.

In the present description and in the claims the expression "climacteric fruit" is used to indicate a fruit the ripening of which comprises a step characterized by the appearance of a breathing peak (climacteric peak) and by an increase in the production of ethylene (C_2H_4). Examples of climacteric fruit are bananas, apples, pears, peaches, plums, nectarines, tomatoes.

It is known that bananas arrive on distribution markets a long time after they have been picked. Bananas are picked from the tree while still unripe and are transported by transport means such as ships (banana-boats), cars or containers, toward the countries of the distribution markets. In the transport means, the unripe bananas are kept in a refrigerator and when they are unloaded they are transferred to other refrigeration cells from which they are removed in relation to market demand, when they have to be made to ripen. Their ripening is caused by creating, in ripening cells, suitable conditions of temperature, degree of relative humidity, and, especially, providing them with a suitable quantity of ethylene to trigger their ripening process. In particular, in the ripening cells air is added (about 20% of oxygen (O_2) and 80% of nitrogen (N_2)) with the addition of about 0.1% of ethylene; relative humidity is adjusted to 90-95% and temperature to 20-22°C. The bananas are kept in the ripening cells for about forty-eight hours. Periodically, the air is changed to avoid an accumulation of carbon dioxide (CO_2) that would produce fermentation in the bananas.

When the bananas have reached the desired degree of ripening, they are distributed in the points of sale to the public. Once put on sale, the bananas must be consumed within the space of a week, at most.

In addition to being complex and expensive due to the need to use ripening cells, this process is also fairly rigid in that, once the ripening process has started in the cells, the bananas must be sold and consumed in a comparatively short time interval.

Similar problems also occur for other climacteric fruit.

The object of the present invention is a method for packaging climacteric fruit and a package containing the same fruit that allow their distribution cycle to be made simpler, flexible and economical.

The abovementioned object is achieved, according to the invention, with a method for packaging and a package of climacteric fruit by means of which the unripe (green) fruit are kept, at room temperature and for a certain period of time, in bags with given characteristics of permeability to gas and aqueous vapour, filled with a modified atmosphere. At the desired moment, the fruit is made to ripen simply by opening the bag and leaving the fruit under environmental conditions for a further given period of time.

It is an object of the invention to provide a method for packaging climacteric fruit comprising the following steps:

a) insertion of at least one unripe fruit in a bag of a suitable material;
b) filling said bag with a modified atmosphere; and
c) hermetic sealing of said bag;

characterized in that

d) said material has a preselected permeability to gas and aqueous vapour and
e) said modified atmosphere comprises oxygen in a quantity ranging from 2% to 20% by volume, carbon dioxide in a quantity ranging from 0% to 20% by volume, ethylene in a quantity ranging from 0% to 3% by volume, the remainder being nitrogen (N_2).

It is a second object of the invention to provide a package for climacteric fruit comprising at least one bag of suitable material, containing at least one unripe fruit, filled with a modified atmosphere and hermetically sealed, characterized in that said material has a preselected permeability to gas and aqueous vapour and said modified atmosphere comprises oxygen in a quantity ranging from 2% to 20% by volume, carbon dioxide in a quantity ranging from 0% to 20% by volume, ethylene in a quantity ranging from 0% to 3% by volume, the remainder being nitrogen.

Preferably, the characteristics of permeability to gases and to aqueous vapour of said material forming said bag are selected so as to keep the composition of the modified atmosphere inside said bag substantially constant.

With the method of packaging and the package according to the invention it is possible to keep unripe fruit at room temperature for periods of about two, three months. After which, in order to trigger the ripening process, it is sufficient to open the bag. About a day and a half, two days, after the opening of the bag, the fruit reaches complete ripening and exhibits organoleptic qualities comparable to those of fruit ripened in the ripening cells. The ripening of the fruit according to the present invention can be activated at any time, by opening the bag that contains them, about two, three days after packaging.

The method of packaging and the package according to the invention exhibits several advantages. They simplify the distribution cycle of the fruit, they reduce its costs and they make it more flexible. In fact, they allow the usual ripening cells as well as the refrigeration cells to be eliminated, if the fruit is packaged immediately after being unloaded from the transport means. Moreover, they allow the consumer to keep the fruit without particular precautions up to the end of the storage period (about two, three months) and, especially, they allow the fruit to be consumed at the time that is felt most appropriate.

Features and advantages of the invention will now be illustrated with reference to a preferred embodiment represented as a non-limiting example in the enclosed figure which shows a package for climacteric fruit, particularly bananas, according to the invention.

In the figure it is shown a package 1 for a banana 2, comprising a bag 3 formed by a film of suitable material having a preselected permeability to gases and to aqueous vapour. The bag 3 is closed hermetically along edges 4.

The material of the bag 3 is selected from the group comprising: low-density polyethylene (LDPE), polyethylene (PE), high-density polyethylene (HDPE), polypropylene (PP), oriented polypropylene (OPP), polyvinylchloride (PVC), oriented polystyrene (OPS), polyethylene terephthlate (PET), polyvinyl acetate (EVA), polyvinyl alcohol (EVOH).

The film of the bag 3 has a thickness ranging from 20 to 50 microns, preferably 35 microns.

The bag 3 is filled with a modified atmosphere comprising oxygen in a quantity ranging from 2% to 20% by volume, preferably from 2% to 6% by volume, carbon dioxide in a quantity ranging from 0% to 20% by volume, preferably from 6% to 13% by volume, ethylene in a quantity ranging from 0% to 3% by volume, preferably from 0.1% to 1.5% by volume, the remainder being nitrogen.

Typically, the bag 3 is formed by a film of LDPE 35 microns thick having permeability to oxygen equal to 6,800 cm^3/m^2 24 h atm, to carbon dioxide equal to 25,000 cm^3/m^2 24 h atm, to ethylene equal to 22,000 cm^3/m^2 24 h atm, where permeability is determined with the method of ASTM-D 1434. Permeability to aqueous vapour is equal to 10 g/m^2 24 h, determined according to the method ASTM 389 83. The bag contains a modified atmosphere comprising 2% by volume of oxygen, 8% by volume of carbon dioxide, 0.1% of ethylene and 89.9% of nitrogen.

The package 1 is prepared when the bananas are still unripe (green), after being unloaded from the banana-boats or after a stay in refrigeration cells. The procedure is to insert in the bag 3 one still unripe banana 2, or two or more bananas. Then the bag 3 is filled with the modified atmosphere having the composition indicated above and it is closed hermetically by sealing under heat. Filling the bag 3 with the modified atmosphere and sealing under heat are performed with traditional packaging machines, provided with cylinders for the supply of the required gases. The package 1 can be kept at room temperature for about two, three months. In the bag 3 the composition of the modified atmosphere remains substantially constant. During this period of time, starting with about the second, third day after packaging, the banana can be made to ripen at any time by opening the bag 3 and leaving it under environmental conditions for a day and a half, two days.

Tests performed on bananas, kept with the method of the present invention and ripened after opening the bags that contained them, exhibit characteristics that are similar to those of fruit ripened in the ripening cells: weight drop equal to about 1%, refractometric residue (percentage of sugar) equal to about 20%. Moreover, they have the following Cie-Lab colour parameters: "a" (turn from green to red) equal to about 2%, "b" (turn toward yellow) equal to about 45%, "L" (brightness) equal to about 65%.

Claims

1. A method for packaging climacteric fruit (2) comprising the following steps:

   a) insertion of at least one unripe fruit (2) in a bag (3) of a suitable material;
   b) filling said bag (3) with a modified atmosphere; and
   c) hermetic sealing of said bag (3);

   characterized in that

   d) said material has a preselected permeability to gas and aqueous vapour and
   e) said modified atmosphere comprises oxygen in a quantity ranging from 2% to 20% by volume, carbon dioxide in a quantity ranging from 0% to 20% by volume, ethylene in a quantity ranging from 0% to 3% by volume, the remainder being nitrogen (N_2).

2. A method according to claim 1, characterized in that the characteristics of permeability to gases and to aqueous vapour of said material forming said bag (3) are selected so as to keep the composition of the modified atmosphere inside said bag (3) substantially constant.

3. A method according to claim 1 or 2, characterized in that said modified atmosphere comprises oxygen in a quantity ranging from 2% to 20% by volume, carbon dioxide in a quantity ranging from 0% to 20% by volume, ethylene in a quantity ranging from 0% to 3% by volume and the remainder nitrogen.

4. A method according to claim 3, characterized in that said oxygen ranges from 2% to 6% by volume, said carbon dioxide ranges from 6% to 13% by volume and said ethylene ranges from 0.1% to 1.5% by volume.

5. A method according to claim 4, characterized in that said oxygen is equal to 2% by volume, said carbon dioxide is equal to 8% by volume and said ethylene is equal to 0.1%.

6. A method according to any of the preceding claims from 1 to 5, characterized in that said bag is formed by a film of plastic material selected from the following: LDPE, PE, HDPE, PP, OPP, PVC, OPS, PET,

EVA, EVOH.

7. A method according to any of the preceding claims from 1 to 6, characterized in that said bag is formed by a film of LDPE having permeability to oxygen equal to 6,800 cm^3/m^2 24 h atm, to carbon dioxide equal to 25,000 cm^3/m^2 24 h atm, to ethylene equal to 22,000 cm^3/m^2 24 h atm and to aqueous vapour equal to 10 g/m^2 24 h.

8. A method according to claims 6 and 7, characterized in that said film has a thickness ranging from 20 to 50 microns.

9. A method according to claims 6 and 7, characterized in that said film is a film of LDPE 35 microns thick.

10. A package (1) for climacteric fruit (2) comprising at least one bag (3) of suitable material, containing at least one unripe fruit (2), filled with a modified atmosphere and hermetically sealed, characterized in that said material has a preselected permeability to gas and aqueous vapour and said modified atmosphere comprises oxygen in a quantity ranging from 2% to 20% by volume, carbon dioxide in a quantity ranging from 0% to 20% by volume, ethylene in a quantity ranging from 0% to 3% by volume, the remainder being nitrogen.

11. A package (1) according to claim 10, characterized in that the characteristics of permeability to gases and to aqueous vapour of said material forming said bag (3) are selected so as to keep the composition of the modified atmosphere inside said bag (3) substantially constant.

12. A package (1) according to claim 10 or 11, characterized in that said modified atmosphere comprises oxygen in a quantity ranging from 2% to 20% by volume, carbon dioxide in a quantity ranging from 0% to 20% by volume, ethylene in a quantity ranging from 0% to 3% by volume and the remainder nitrogen.

13. A package (1) according to claim 12, characterized in that said oxygen ranges from 2% to 6% by volume, said carbon dioxide ranges from 6% to 13% by volume and said ethylene ranges from 0.1% to 1.5% by volume.

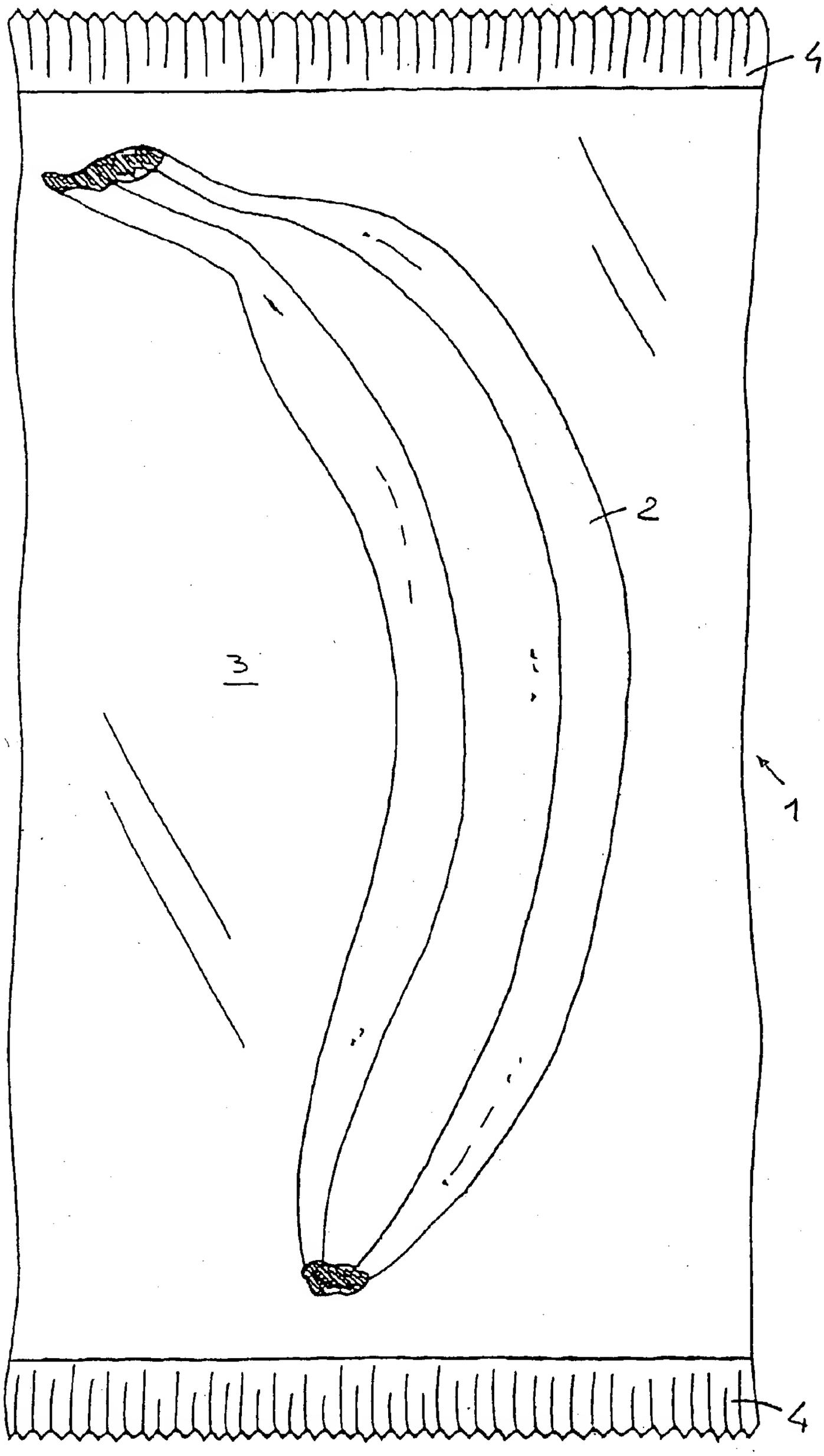
14. A package (1) according to claim 13, characterized in that said oxygen is equal to 2% by volume, said carbon dioxide is equal to 8% by volume and said ethylene is equal to 0.1%.

15. A package (1) according to any of the preceding claims from 10 to 14, characterized in that said bag (3) is formed by a film of plastic material selected from the following: LDPE, PE, HDPE, PP, OPP, PVC, OPS, PET, EVA, EVOH.

16. A package (1) according to any of the preceding claims from 10 to 15, characterized in that said bag (3) is formed by a film of LDPE having permeability to oxygen equal to 6,800 cm^3/m^2 24 h atm, to carbon dioxide equal to 25,000 cm^3/m^2 24 h atm, to ethylene equal to 22,000 cm^3/m^2 24 h atm and to aqueous vapour equal to 10 g/m^2 24 h.

17. A package (1) according to claims 15 and 16, characterized in that said film has a thickness ranging from 20 to 50 microns.

18. A package (1) according to claims 15 and 16, characterized in that said film is a film of LDPE 35 microns thick.



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EUROPEAN SEARCH REPORT

Application Number
EP 96 20 1787

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X Y	US-A-4 943 440 (ARMSTRONG GLENN S) 24 July 1990 * abstract * * column 3, line 15 - line 47 *	1-5, 10-14 6-9, 15-18	B65D81/20
Y	US-A-3 795 749 (CUMMIN A ET AL) 5 March 1974 * column 2, line 10 - column 3, line 3 *	6-9, 15-18	
A	US-A-4 079 152 (BEDROSIAN KARAKIAN ET AL) 14 March 1978 * column 2, line 8 - line 28 *	1-18	
A	US-A-4 883 674 (FAN STEVE T) 28 November 1989 * examples *	1-18	
A	US-A-5 165 947 (COLUCCI MICHAEL J ET AL) 24 November 1992 * column 5, line 45 - column 7, line 38 *	1-18	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

B65D
A23B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	27 September 1996	Olsson, B

EPO FORM 1503 03.82 (P04C01)

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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